SHEET WIPER

FIELD OF THE INVENTION

The present invention relates generally to sheet wipers of the type used in cleansing surfaces in a controlled environment, such as in an industrial cleanroom, paint shop, or medical facility. The present invention also relates to an apparatus and method for packaging and dispensing sheet wipers, and further to a method of manufacturing sheet wipers.

Background of the Invention

Packaged wipers for cleansing surfaces in controlled environments have been provided. A plurality of sheet wipers are typically placed into the interior cavity of a package container. Depending upon the application, the individual wipers may be comprised of knitted, woven, or nonwoven fabrics. Further, the packaged wipers may be provided dry or presaturated with a liquid solvent. These liquid solvents may include volatile organic compounds (VOC's) such as isopropyl alcohol or naptha, as well other materials such as deionized or purified water. The solvent compositions may also include other ingredients such as dipropylene glycol monomethylether. Typically, sheet wipers have been provided in sizes of 81 $in.^2$ (9 in. x 9 in.) or in 144 $in.^2$ (12 in. x 12 in.).

For use in the most stringent cleanroom environments, wipers are generally made from knitted fabrics of filament nylon or polyester yarn. These wipers have traditionally been manufactured into square or rectangular configurations by cutting the fabric into the desired

size wiper using a textile knife. This cutting process generates extraneous fibers, in part because the knitted loops are cut. The cut fiber pieces remain on the fabric and represent a potential for contamination. To remove this contaminant, the wipers are often laundered in a cleanroom washing operation. After extraneous fibers are removed in this manner, the wipers are packaged, in either dry or presaturated form, and are ready for use.

In part to reduce contaminant potential, sealed edge wipers were developed. Although there are several methods of producing sealed edge wipers, the basic premise is the same. Specifically, these products are made using converting operations that actually fuse the cut loops into the edge of the wiper. This generally creates a cleaner cut and reduces fiber contamination at the edges. While these sealed-edge wipers are generally cleaner than conventional knife cut edges, they still tend to be more contaminated than the base fabric alone. The sealed-edge products are also typically cleanroom laundered before they are packaged.

In some environments, additional means are employed to further reduce the contaminant potential of cut wipers. For example, in order to minimize contact with the cut edges of a wiper, an operator may fold the wiper prior to application. One such protocol requires that a square wiper be folded in half such that there are two short sides and two long sides. Then the wiper is folded in half again, short side to short side, such that the folded wiper has four equal-length sides. In this configuration, two of the wiper's sides are cut edges, and the remaining two sides are folded surfaces. During application of the wiper to a surface, the operator may orient the wiper such that surface contact with the cut edges is minimized. Application of the folded wiper in this manner will generally reduce contaminant

potential. Further, if the applied face of the wiper becomes soiled, the operator may unfold the wiper and then refold it, so that an unused face of the wiper may be applied to the surface in the manner described.

As described above, several techniques may be used to reduce the level of contaminant potential posed by a wiper. Although these techniques may significantly reduce the contaminant level of cut wipers, some environments may benefit from still lower contaminant levels.

Summary of the Invention

The present invention recognizes and addresses the foregoing disadvantages, and others, of prior art constructions and methods.

In one aspect, the present invention provides an improved sheet wiper. More particularly, the present invention provides an improved fabric wiper with a lower level of contaminants than prior art fabric wipers of comparable surface area. In addition, the present invention maximizes the usable area of a wiper and thus minimizes wasted wiper area.

It has been determined that the contamination level of a fabric wiper is related to the ratio of Wiper Area/Wiper Perimeter. For example, for square or rectangular cut wipers of the prior art, larger size wipers (with a higher Area/Perimeter ratio) tend to be cleaner than smaller size wipers (with a lower Area/Perimeter ratio). Therefore, a superior wiper design would maximize the Wiper Area/Wiper Perimeter ratio for any desired area of wiper. For customary wiper sizes, a circular wiper would present the cleanest configuration; however, the circular configuration would generally be inefficient to manufacture.

A preferred embodiment of the present invention provides a knitted fabric wiper with a hexagonal configuration of substantially uniform edge lengths. The improved hexagonal wiper design increases the Area/Perimeter ratio over like-sized square and rectangular wipers of the prior art. Accordingly, the present invention provides a wiper that is generally cleaner than equivalent area wipers of the prior art. Further, the hexagonal design provides for an efficient manufacturing process. In other preferred embodiments of the present invention, the edge lengths may be varied for individual edges, or for pairs of opposing edges to achieve desired wiper profiles.

Effective wiping is best done when the pressure of the hand is directly above the fabric as it contacts the surface being wiped. Conversely, area in a fabric wiper which is not directly under the hand is of little use. In comparison to prior art square and rectangular wipers, the hexagonal wiper more closely approximates the shape of a user's hand with fingers spread apart in a wiping application. As a result, there is less unused area present in a hexagonal wiper of the present invention. Thus, the improved hexagonal configuration of the present invention is effective in maximizing the usable area of a wiper.

In another aspect, the present invention provides a package of improved knitted wiper cloths for cleaning surfaces in a controlled environment. The package comprises a container defining an interior cavity having a plurality of wiper cloths contained therein. The wiper cloths have a hexagonal configuration and may be in dry or presaturated form.

In one embodiment, dry or presaturated hexagonal wipers having substantially equal edge lengths are packaged in a generally cylindrical container, such as a bucket. Inside the container, the hexagonal wipers are stacked in a pile, preferably such that the edges of the

wipers are approximately aligned. Preferably, the stack of aligned hexagonal wipers closely approximates the shape and size of the cylindrical container interior. As a result, the container can be densely packed with wipers, and very little space will be wasted.

In yet another aspect of the present invention, a methodology is provided for fabricating knitted wiper cloths of the type for cleaning surfaces in a controlled environment. Initially, a sheet comprising a knitted fabric web of filament synthetic yarn, such as nylon or polyester yarn, is produced. This fabric web is then sent to a cutting operation for sonic, laser, hot air, or hot knife cutting. During this operation, the fabric web is cut into a honeycomb pattern of hexagonally shaped wipers. The hexagonally shaped wipers are then laundered to remove extraneous matter generated during the knitting, finishing or cutting process. Typically, the wipers are laundered to the extent that a wiper in deionized water releases fewer than about 10 million particles of a size greater than about 0.5μm per square meter of apparent surface area of the faces. After the wipers are laundered, they are assembled in groups of a predetermined quantity. Each group of wipers is then packaged, and saturated if desired.

Broadly, in one aspect, the present invention concerns a wiper comprised of sheet material such as knitted, woven and nonwoven fabrics having two opposing faces and six edges, wherein the six edges may be of equal or unequal lengths.

Broadly, in another aspect, the present invention concerns an apparatus for dispensing a plurality of six-sided sheet material wipers comprising a receptacle having a cross-sectional area which exceeds the area of the face of said wipers, which receptacle may comprise a bag or other container and may include a means for resealing, such as a removable cover or lid.

Broadly, in another aspect, the present invention concerns a method of dispensing six-sided wipers made of sheet material comprising stacking a plurality of said wipers in a receptacle, which receptacle may include a means for resealing, such as a removable cover or lid.

Broadly, in yet another one aspect, the present invention concerns a method of manufacturing six-sided wipers from sheet material by cutting a plurality of hexagonal forms oriented such that adjacent forms share common edges with cutting means that includes sonic, laser, hot air, and hot knife.

Other objects, features, and aspects of the present invention are discussed below.

Brief Description of the Drawings

A full and enabling disclosure of the present invention, including the best mode thereof, to one of ordinary skill in the art, is set forth more particularly in the remainder of the specification, including reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a prior art rectangular wiper constructed in accordance with the prior art;

Figure 2 is a plan view of a hexagonal fabric wiper constructed in accordance with the present invention;

Figures 3 and 4 illustrate usage of the wipers shown in Figures 1 and 2, respectively;

Figures 5A, 5B, and 5C illustrate a method of folding prior art wipers;

Figures 6A, 6B, and 6C illustrate a method of folding hexagonal wipers in accordance with the present invention;

Figure 7 is a cross-sectional view of a package, in one embodiment, of improved wipers constructed in accordance with the present invention;

Figure 8A is a cross-sectional view of a stack of hexagonal wipers contained in a bucket;

Figure 8B is a view of the stack of wipers shown in Figure 8A as seen from above with the lid removed; and

Figure 9 is a plan view of a fabric web diagrammatically illustrating the cutting of individual wipers therefrom in accordance with the present invention.

The drawings are provided for illustrative purposes only and should not be used to unduly limit the scope of the invention.

Detailed Description of the Preferred Embodiments

It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not intended as limiting the broader aspects of the present invention, which broader aspects are embodied in the exemplary constructions.

Figure 1 illustrates a single wiper cloth **10** made according to the prior art. Wiper cloth **10** generally has a square or rectangular configuration. These configurations allow for an efficient manufacturing process and provide wiper cloths of generally acceptable contamination levels. However, some environments may benefit from wipers having an even lower level of contaminants.

Figure 2 illustrates a single wiper cloth **20** made in accordance with one aspect of the present invention. Wiper cloth **20** has a hexagonal configuration with edges a-f all having

substantially the same length. Of course, many other variations of the present invention are obtained by varying the lengths of the edges. Like the prior art, the hexagonal configuration also allows for an efficient manufacturing process. In addition, the present invention provides a wiper cloth **20** that will often contain less contaminants than a comparably sized square or rectangular wiper of the prior art.

It has been determined that the contamination level of a cut fabric wiper is related to the ratio of Wiper Area/Wiper Perimeter. For example, a first wiper A of a specified area and perimeter is compared to a similarly constructed second wiper B having the same area but a smaller perimeter. Wiper B will generally be a cleaner wiper, because wiper B has a higher Area/Perimeter ratio.

As an illustration, assume that prior art wiper **10** shown in Figure 1 has a wiper area equal to that of wiper **20** shown in Figure 2. In comparison to the wiper **10**, the hexagonal wiper **20** of the present invention has a shorter perimeter. Therefore, wiper **20** will generally contain a lower level of contaminants than wiper **10**, assuming similar materials, processing steps, and the like.

Figure 3 compares the shape of a user's hand **32** to the shape of a prior art wiper **10**. As shown, the user's fingers **34** are spread over the wiper **10** as would be done in a wiping application. Wiper area directly under the user's hand and fingers represents usable surface area. Conversely, area of the wiper **10** not located under the user's hand and fingers is basically unused.

Figure 4 compares the shape of a user's hand **32** to a wiper **20** made in accordance with the present invention. In comparison to wiper **10** of the prior art, the hexagonal

configuration of the present invention more closely approximates the shape of the hand **32** with fingers **34** spread as in a wiping application. Accordingly, the present invention is generally more effective in maximizing the usable area of a wiper. This means that the hexagonally configured wiper **20** of the present invention may have a smaller overall area than a wiper **10** of the prior art while providing the same amount of usable area.

For example, a hexagonal wiper having an area of no more than about 72 $in.^2$ may be used where a 81 $in.^2$ square or rectangular wiper has been used in the past. Similarly, a hexagonal wiper of no more than about 124 $in.^2$ compares to a 144 $in.^2$ square or rectangular wiper of the prior art. In addition to reducing the perimeter length of the wiper and the potential for contaminant represented thereby, a smaller area wiper will often yield a cost savings in manufacturing. A smaller area wiper permits savings on material costs and allows more wipers to be laundered at one time.

A smaller area wiper also allows the most efficient use of solvent applied with the wiper, thus minimizing the amount of solvent used. Minimizing the amount of solvent used is desirable from the standpoints of the cost of the solvents, the effectiveness of their application to the surface, and minimizing the solvent concentration in the atmosphere of the users' environment. The latter involves both the health of the users who are breathing this atmosphere and the safety of the users in an environment where volatile liquids such as solvents may pose a fire hazard. Additionally, it is well known that reducing VOC's released to the atmosphere poses a positive impact on the environment.

Another advantage of the present invention is realized by those who follow a protocol which requires the use of a folded wiper. In general, folding a square or rectangular wiper of

the prior art requires the use of both hands. Conversely, folding a hexagonal wiper of the present invention generally can be accomplished with one hand. As a result, a user can fold the present wiper with one hand and manage a product or tool in the other hand.

The prior art folding process is illustrated in Figures 5A, 5B, and 5C, while the present folding process is illustrated in Figures 6A, 6B, and 6C. In Figure 5A, the bottom half of wiper **10** is gripped by the user at two corner locations **51** and is folded over the top half. In Figure 5B, the right half of wiper **10** is gripped at two locations **53** and is folded over the left half. The resulting folded wiper **54** has two cut edges **56** and two folded sides **58**. As illustrated, folding a wiper **10** of the prior art generally requires two hands.

In Figure 6A, the bottom half of the present wiper **20** is gripped at a single location **61** and is folded over the top half. In Figure 6B, the right half of wiper **20** is gripped at a single location **63** and is folded over the left half. As with the prior art wiper **54**, the resulting folded wiper **64** of the present invention has two cut edges **66** and two folded sides **68**. However, as illustrated, folding a wiper **20** of the present invention generally requires only one hand. In order to achieve desired wiper profiles in a folded configuration, the edge lengths of the present invention may be varied for individual edges, or for pairs of opposing edges, such as illustrated by edges a and d in Figure 2.

Figure 7 illustrates a package **70** of improved wipers constructed in accordance with one aspect of the present invention. The package **70** comprises a bag **72**, typically of polymeric, foil, or other sheet material, defining a container having a stack **74** of wiper cloths located therein. Bag **72** is closable at its open end **76**, using a bag tie, a tongue-and-groove mechanism such as that sold under the mark ZIP-LOCK, or other sealing device. In some

exemplary embodiments, pack **70** may include a total of 150 dry or presaturated wiper cloths. These packages may themselves be packaged for resale in multiples, such as multiples of two (2).

Figures 8A and 8B illustrate another package **80** of improved wipers constructed in accordance with a further aspect of the present invention. The package **80** includes a generally cylindrical bucket **82**, typically made of a suitable plastic, having a stack **84** of wiper cloths located therein. A removable lid **86** is located atop bucket **82** to close and seal the opening. In some exemplary embodiments, the wipers within the bucket may be saturated with a predetermined solvent. Additionally, the wipers may be stacked such that the edges **88** of the hexagonal wipers are at least approximately aligned. As such, the stack **84** of wipers closely conforms to the shape of the inside of the bucket **82**.

Figure 9 helps illustrate a methodology for fabricating wipers in accordance with another aspect of the present invention. The preferred sheet material is a knitted polyester fabric, but the scope of the invention may include other knitted synthetic fabrics, or even sheet materials of woven or nonwoven fabrics depending on the requirements of a particular usage. In the preferred method, a fabric web is cut into a plurality of hexagonal forms in a honeycomb configuration, such that adjacent forms share common edges, thus minimizing cutting operations and wastage of sheet material. In an example utilization of the preferred method depicted in Figure 9, a fabric web **94** is cut into rows of hexagonal forms in a honeycomb configuration such that each hexagonal cutout in a row shares a common side with adjacent cutouts in the row. Also, each successive row of cutouts may be offset a distance equal to one-half the width of the hexagonal form, such that each hexagonal form

shares one common side with each of two adjacent forms in the succeeding row. A cutting mechanism, such as a laser cutting device, can be utilized to cut the fabric web along the broken lines **96** of the hexagonal honeycomb. A plurality of individual hexagonally shaped wipers **20** can be produced in this manner.

In order to remove contaminants introduced during the cutting process, the wipers may be taken to a cleanroom laundry and laundered in a washing application. After extraneous fibers are removed in this manner, the wipers are grouped in a predetermined quantity, and stacked if desired. The groups of wipers are then packaged, in either dry or presaturated form, and readied for sale.

Manufacturing the wipers in a hexagonal honeycomb configuration is an efficient production method. Generally, the hexagonally shaped wipers will use less sheet material, while having the same usable area as those of the prior art. As a result, the production method of the present invention may provide cost savings to the manufacturer.

While preferred embodiments of the invention and preferred methods of practicing the same have been shown and described, modification and variations thereto may be practiced by those of ordinary skill in the art without departing from the spirit and scope of the present invention. In addition, it should be understood that aspects of the various embodiments may be interchanged both in whole or in part. Furthermore, those of ordinary skill in the art will appreciate the foregoing description is by way of example only, and is not intended to be limitative of the invention.